

**What is claimed is:**

1. An apparatus for a high-temperature industrial process comprising at least one flanged connection, wherein at least one flange of the at least one flanged connection is protected from mechanical damage by at least one support lug attached to the at least one flange.
2. The apparatus of claim 1 further comprising a cooling jacket attached to the at least one flange.
3. The apparatus of claim 2, wherein the cooling jacket further comprises a  $\frac{1}{2}$  pipe.
4. An apparatus for a high-temperature industrial process comprising at least one flanged connection, wherein the flange is cooled by an attached  $\frac{1}{2}$  pipe cooling jacket.
5. An apparatus for a high-temperature industrial process, comprising:
  - a) an inlet piping section with a first cross-sectional dimension;
  - b) a downstream process section with a second cross-sectional dimension;
  - c) an inlet transition section connecting the inlet piping section and downstream process section;
 wherein the transition section comprises internal insulation comprising refractory ceramic fiber.
6. The apparatus of claim 5 wherein the second cross-sectional dimension is larger than the first cross-sectional dimension.
7. The apparatus of claim 5 wherein the internal insulation forms a conical interior surface.
8. The apparatus of claim 7 wherein the inlet transition section comprises a domed geometry.
9. The apparatus of claim 8 where the transition section is a reactor head comprising a flanged connection to the downstream process section.
10. The apparatus of claim 7 wherein the inlet transition section comprises a conical geometry.

11. The apparatus of claim 10 wherein the inlet transition section is a reactor head comprising a flanged connection to the downstream process section.
12. The apparatus of claim 5 further comprising one or more sight glass nozzles.
13. The apparatus of claim 5, wherein a laminar velocity profile is achieved in the downstream process section using at least one of:
  - a) a sufficient length of straight pipe comprising the inlet piping section to provide laminar flow at an upstream end of the inlet transition section;
  - b) at least one CRV disposed within the inlet piping section;
  - c) an LAD at the upstream end of the inlet transition section;
  - d) an EHD at the upstream end of the inlet transition section; and
  - e) a conical interior surface comprising the transition section
14. An apparatus for a high temperature industrial process comprising:
  - a) a process section having a first cross-sectional dimension;
  - b) outlet piping having a second cross-sectional dimension smaller than the first cross-sectional dimension; and
  - c) an outlet transition section connecting the outlet piping section and the process section;wherein an internal surface of the outlet transition section is conical.
15. The apparatus of claim 14 wherein the outlet transition section comprises internal insulation further comprising refractory ceramic fiber.
16. The apparatus of claim 15 wherein the outlet transition section is a domed head comprising at least one flanged connection
17. The apparatus of claim 14 wherein the outlet transition section is a conical head comprising at least one flanged connection.
18. An apparatus for a high-temperature industrial process comprising:
  - a) a reactor head having a bottom flange;
  - b) a downstream process section with a top flange;

wherein a working elevation of the downstream process section top flange is between about 2.0 and 3.5 feet.

19. The apparatus of claim 18 wherein the downstream process section further comprises at least one thermocouple nozzle.
20. The apparatus of claim 18 wherein the reactor head further comprises internal insulation comprising refractory ceramic fiber.
21. The apparatus of claim 20 wherein the internal insulation comprises a conical interior surface.
22. An apparatus for a high-temperature industrial process comprising:
  - a) an inlet piping section;
  - b) an inlet transition section;
  - c) a process section;
  - d) an outlet transition section; and
  - e) an outlet piping section;

wherein internal insulation is included in one or more of the apparatus sections, and wherein the insulation comprises refractory ceramic fiber.

23. The apparatus of claim 22 wherein the inlet transition section further comprises a conical interior surface.
24. The apparatus of claim 22 wherein the outlet transition section further comprises a conical interior surface.
25. The apparatus of claim 22 further comprising a flanged connection having first and second flanges between the inlet transition section and the process section.
26. The apparatus of claim 25 wherein at least one of first and second flanges includes a cooling jacket attached thereto.
27. The apparatus of claim 25 wherein at least one of first and second flanges includes at least one support lug.
28. The apparatus of claim 22 further comprising a flanged connection having first and second flanges between the process section and the outlet transition section.

29. The apparatus of claim 28 wherein at least one of first and second flanges includes at least one support lug.
30. The apparatus of claim 28 wherein at least one of first and second flanges includes a cooling jacket attached thereto.
31. The apparatus of claim 22 wherein the inlet transition section further comprises at least one sight glass nozzle.
32. The apparatus of claim 22 wherein the working elevation of the process section is between about 2.0 and 3.5 feet.
33. The apparatus of claim 22 wherein the process section further comprises at least one instrument nozzle.
34. A process of producing hydrogen cyanide comprising:
  - a) providing at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas;
  - b) reacting the at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas in an apparatus to form hydrogen cyanide, and
  - c) supplying heat by a simultaneous combustion reaction with the at least one oxygen containing gas in the apparatus;wherein the apparatus comprises: at least one flanged connection wherein at least one flange of the at least one flanged connection is protected from mechanical damage by at least one support lug attached to the at least one flange.
35. A process of producing hydrogen cyanide comprising:
  - a) providing at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas;
  - b) reacting the at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas in an apparatus to form hydrogen cyanide, and
  - c) supplying heat by a simultaneous combustion reaction with the at least one oxygen containing gas in the apparatus;

wherein the apparatus comprises:

an inlet piping section with a first cross-sectional dimension;

a downstream process section with a second cross-sectional dimension;

an inlet transition section connecting the inlet piping section and downstream process section;

wherein the transition section comprises internal insulation comprising refractory ceramic fiber.

36. An apparatus comprising:

a) a reactor head;

b) insulation insertable into the reactor head, said insulation comprising a refractory ceramic fiber;

wherein the reactor head is adapted to connect with a fluid stream to facilitate a chemical process.

37. The apparatus of claim 36 wherein the reactor head is generally cone-shaped.

38. The apparatus of claim 37 wherein an angle between a conical reactor head wall and a vertical line adjacent thereto is less than about 25°.

39. The apparatus of claim 36 wherein the reactor is dome-shaped.

40. The apparatus of claim 39 wherein the reactor is coupled with a large angle diffuser to induce a flow pattern functionally equivalent to that of the conical reactor head in claim 38.

41. The apparatus of claim 36 wherein the insulation is removable from the reactor head as a single piece.

42. The apparatus of claim 36 further comprising at least one sight glass located in the side of the reactor head and extending through the insulation.

43. The apparatus of claim 36 wherein the insulation is held in position by at least one sleeve extending through both the reactor and the insulation.

44. The apparatus of claim 36 wherein the insulation is secured within the reactor by an internal collar extending concentrically into an inlet of the reactor head.

45. The apparatus of claim 36 wherein the chemical process is hydrogen cyanide production.

46. The apparatus of claim 36 further comprising a cooling jacket disposed around the reactor head, the cooling jacket comprising a half-pipe attached to an outer surface of the reactor head.

47. The apparatus of claim 36 further comprising one or more flow straightening apparatus upstream of the reactor head.

48. An apparatus comprising:

- a) a reactor head;
- b) at least one flange having a circumferential surface and a coupling surface, the coupling surface being adapted to be coupled with a mating flange in a chemical process unit;
- c) at least one support lug attached to the at least one flange and capable of supporting the reactor head;

wherein the at least one support lug extends from the circumferential and coupling surfaces such that a clearance is created between the coupling surface and the support lugs.

49. The apparatus of claim 48 further comprising one or more additional support lugs attached to the at least one flange and capable of supporting the reactor head.

50. The apparatus of claim 49 wherein the at least two support lugs are generally U-shaped.

51. The apparatus of claim 50 wherein the at least two support lugs extend around a cooling jacket mounted to the at least one flange.

52. The apparatus of claim 50 wherein the at least two support lugs have a generally circular hole drilled therethrough to facilitate cooling of the at least two support lugs.

53. The apparatus of claim 48 wherein the reactor head is generally cone-shaped

54. The apparatus of claim 53 wherein an angle between a conical reactor head wall and a vertical line is less than about 25°.

55. An apparatus comprising:

- a) a reactor head;
- b) a catalyst-bearing barrel adapted to be coupled to the reactor head;

wherein the catalyst-bearing barrel exhibits a working vertical elevation between about 2.0 and about 3.5 feet and is adapted to facilitate acceptance of a catalyst or other apparatus maneuvered by one or more operators standing outside the diameter of the barrel when the catalyst-bearing barrel is uncoupled from the reactor head.

56. The apparatus of claim 55 wherein the reactor head is generally cone-shaped.

57. An apparatus comprising:

- a) a reactor head;
- b) a catalyst-bearing barrel adapted to be coupled to the reactor head; and
- c) at least one instrument nozzle having an internal passageway adapted to house an instrument mounted in the side of the catalyst-bearing barrel at a non-normal angle such that there is no direct line of sight between the catalyst elevation and the internal passageway.

58. The apparatus of claim 57 wherein the non-normal angle is about 77°.

59. The apparatus of claim 57 wherein the at least one instrument nozzle is adjacent to a reaction zone.

60. The apparatus of claim 57 wherein the reactor head is generally cone-shaped.

61. An apparatus comprising:

- a) a conical reactor head;
- b) insulation, removeably insertable into the conical reactor head comprising a refractory ceramic fiber;
- c) at least one flange having a circumferential surface and a coupling surface, the coupling surface being adapted to be coupled with a mating flange in a chemical process unit;
- d) at least three support lugs attached to the at least one flange and capable of supporting the conical reactor head;

- e) a catalyst-bearing barrel adapted to be coupled to the conical reactor head;
- f) at least one instrument nozzle having an internal passageway adapted to house instruments mounted in the side of the catalyst-bearing barrel at a non-normal angle such that there is no direct line of sight between the catalyst elevation and the internal passageway;

wherein the conical reactor head is adapted to connect with a fluid stream to facilitate a chemical process; and

wherein the at least three support lugs extend from the circumferential and coupling surfaces such that a clearance is created between the coupling surface and the support lugs; and

wherein the catalyst-bearing barrel exhibits a working vertical elevation between about 2.0 and about 3.5 feet and is adapted to facilitate acceptance of a catalyst provided by one or more operators standing outside the diameter of the barrel when the catalyst-bearing barrel is uncoupled from the barrel.

62. A process of producing hydrogen cyanide comprising:

- a) providing at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas;
- b) reacting the at least one hydrocarbon, at least one nitrogen containing gas, and at least one oxygen containing gas in a reactor to form hydrogen cyanide, and
- c) supplying heat by a simultaneous combustion reaction with the at least one oxygen containing gas in the reactor;

wherein the reactor comprises a reactor head, a catalyst-containing barrel member, and insulation insertable into the reactor head, the insulation comprising a refractory ceramic fiber.

63. The process of claim 62 wherein the at least one hydrocarbon is chosen from the list of: methane ( $\text{CH}_4$ ), ethylene ( $\text{C}_2\text{H}_4$ ), ethane ( $\text{C}_2\text{H}_6$ ), propylene ( $\text{C}_3\text{H}_6$ ), propane ( $\text{C}_3\text{H}_8$ ), butane ( $\text{C}_4\text{H}_{10}$ ), methanol ( $\text{CH}_3\text{OH}$ ), toluene, naphtha, and methyl formate.

64. The process of claim 62 wherein the at least one nitrogen containing gas is either ammonia, formamide, or NO.



65. The process of claim 62 wherein the oxygen containing gas is chosen from the list of: air, oxygen-enriched air, pure oxygen gas, carbon monoxide (CO), NO, and carbon dioxide (CO<sub>2</sub>).

66. The process of claim 62 wherein the oxygen containing gas is provided by the decomposition of at least one of the list of: peroxides, ketones, and ethers.